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परिपथ एकीकरण वाली, इलेस्टोमर से
विद्युत रोधित केबलस —
विशिष्टि

**Elastomer Insulated Cables with
Limited Circuit Integrity when
Affected by Fire —
Specification**

ICS 13.220.40;29.020;29.060.20

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FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Power Cables Sectional Committee had been approved by the Electrotechnical Division Council.

This standard covers the requirement of elastomer insulated cables with limited circuit integrity when affected with fire. The cables in this specification are rated for a nominal voltage of 1 100 V. These are used in places for safe evacuation of personal in case of a fire in confined areas such as high rise buildings, power stations, etc., by maintaining the essential electrical services for a limited period. Further, these cables generate very low smoke and halogen acids for maintaining visibility of the area.

This standard has following five sections :

- Section I General
- Section II Materials
- Section III Construction
- Section IV Tests
- Section V Identification, packing and marking

While formulating this standard, assistance has been drawn from the following:

- IEC 60331-11 Tests for Electric Cables under Fire Condition — Circuit Integrity — Part 11: Apparatus – Fire alone at a flame temperature of at least 750°C, issued by International Electrotechnical Commission (2009)
- IEC 60331-21 Tests for Electric cables under fire conditions — Circuit integrity — Part 21: Procedures and requirements – Cables of rated voltage up to and including 0,6 /1,0 kV, issued by International Electrotechnical Commission (1999)

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

Indian Standard

ELASTOMER INSULATED CABLES WITH LIMITED CIRCUIT INTEGRITY WHEN AFFECTED BY FIRE — SPECIFICATION

SECTION 1 GENERAL

1 SCOPE

This standard covers the requirement of heat resisting elastomeric insulated cables for fixed installations for maintaining limited circuit integrity when affected by fire for single phase and three phase system, suitable for operation at voltages up to and including 1100 V.

These cables are suitable for use where combination of ambient temperature and temperature rise due to load results in conductor temperature not exceeding 90°C under normal operation and 250°C under short circuit conditions.

NOTE — The cables conforming to this standard may be operated continuously at a power frequency voltage 10 percent higher than rated voltage.

2 REFERENCES

The standards given below contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreements based on this standard are encouraged to investigate the possibility of applying the most recent editions of the standard indicated below:

<i>IS No.</i>	<i>Title</i>
1885 (Part 32) : 1993 / IEC 50-461 : 1984	Electrotechnical vocabulary: Part 32 Electric cables
3975 : 1999	Mild steel wires, formed wires and tapes for armouring of cables
4826 : 1979	Specification for hot-dipped galvanized coatings on round steel wires
4905 : 1968	Methods for random sampling
6380 : 1984	Elastomeric insulation and sheath of electric cables
8130 : 2013	Conductors for insulated electric cables and flexible cords
10462 (Part 1) : 1983	Fictitious calculation method for determination of dimensions of protective coverings of cables: Part 1 Elastomeric and thermoplastic insulated cables

<i>IS No.</i>	<i>Title</i>
10810	Methods of test for cables :
(Part 0) : 1984	General
(Part 1) : 1984	Annealing test for wires used in conductors
(Part 4) : 1984	Persulphate test of conductor
(Part 5) : 1984	Conductor resistance test
(Part 6) : 1984	Thickness of thermoplastic and elastomeric insulation and sheath
(Part 7) : 1984	Tensile strength and elongation at break of thermoplastic and elastomeric insulation and sheath
(Part 11) : 1984	Thermal ageing in air
(Part 28) : 1984	Water absorption test (Electrical)
(Part 30) : 1984	Hot set test
(Part 36) : 1984	Dimensions of armouring material
(Part 37) : 1984	Tensile strength and elongation at break of armouring materials
(Part 38) : 1984	Torsion test on galvanized steel wires for armouring
(Part 39) : 1984	Winding test on galvanized steel strips for armouring
(Part 40) : 1984	Uniformity of zinc coating on steel armour
(Part 41) : 1984	Mass of zinc coating on steel armour
(Part 42) : 1984	Resistivity test of armour wires and strips and conductance test of armour (wires/strips)
(Part 43) : 1984	Insulation resistance
(Part 45) : 1984	High voltage test
(Part 56) : 1987	Accelerated ageing by the air-pressure method
(Part 58) : 1998	Oxygen index test
(Part 59) : 1988	Determination of the amount of halogen acid gas evolved during combustion of polymeric materials taken from cables
(Part 61) : 1988	Flame retardant test
(Part 62) : 1993	Fire resistance test for bunched cables
(Part 64) : 2003	Measurement of temperature index
10814 : 1984	Method for sampling green coffee in bags

3 TERMINOLOGY

For the purpose of this standard, the definitions given in IS 1885 (Part 32) and the following shall apply.

3.1 Routine Test — Test made by the manufacturer on all finished cable lengths to demonstrate the integrity of the cable.

3.2 Type Tests — Tests required to be made before supply on a general commercial basis a type of cable in order to demonstrate satisfactory performance characteristics to meet the intended application (*see also* Table 1).

NOTE — These tests are of such a nature that after the have been made they need not be repeated unless changes are made in the cable materials or design which might change the performance characteristics.

3.3 Acceptance Tests — Tests carried out on samples taken from a lot for the purpose of acceptance of the lot.

3.4 Optional Tests — Special tests to be carried out, when required, by agreement between the purchaser and the supplier.

3.5 Circuit Integrity — Ability to continue to operate in the designated manner whilst subjected to a flame for a specified period.

SECTION II MATERIALS

4 CONDUCTORS

4.1 Cables for Fixed Installation

The conductors shall consist of either tinned copper or plain copper and shall conform to IS 8130.

5 INSULATION

The insulation shall be of elastomer compound conforming to type IE 2 of IS 6380.

6 TAPE

6.1 Glass Tape

The glass tape shall be either plain or varnished. The thickness of the tape should be approximately 0.15 mm.

6.2 Polyethylene Teraphthalate (PETP) or Polypropylene base Tape

The thickness of the tape shall be between 0.0125 mm and 0.05 mm.

6.3 Any other suitable tape based on glass or composites of glass and other synthetic material.

6.4 Fire Barrier Tape

The fire barrier tape shall be a composite essentially of glass and mica of suitable quality. The nominal thickness of the tape shall be as agreed to between the manufacturer and the customer.

7 CENTRE AND FILLERS

7.1 The centre and filler shall be any one or a combination of the following and shall be non-hygroscopic:

- a) Fibrous materials;
- b) Elastomeric compound (including regenerated or unvulcanized rubber); and
- c) Material similar to inner sheath.

NOTES

1 Material used shall be suitable for the operating temperature of the cable and shall have no deleterious effect on any other component of the cable.

2 The fillers, at the manufacturers' discretion may form an integral part of the rubber sheath.

3 The Elastomeric centre and filler may be reinforced with fibrous material or metallic wires. Where metallic wires are used it shall be earthed.

8 ARMOUR

Armour shall consist of one of the following:

- a) Galvanized round steel wire conforming to IS 3975,
- b) Galvanized formed wires conforming to IS 3975, and
- c) Any non-magnetic material (as agreed to between the purchaser and the manufacturer) and also meets the requirements of this specification.

9 SHEATH

9.1 Inner Sheath

The inner sheath shall consist of elastomeric compound complying with requirements of type SE6 as indicated in Table 2.

NOTE — For certain applications a soft inner sheath may be required. In such cases it shall be as agreed to between the manufacturer and user.

9.2 Outer Sheath

The outer sheath shall be of elastomeric compound type SE6 conforming to requirements indicated in Table 2.

SECTION III CONSTRUCTION

10 CONDUCTORS

10.1 The conductors shall be of either solid or stranded construction, complying with Class 2 of IS 8130.

10.2 Suitable fire barrier tape(s), to be applied between the conductor and the insulation. Suitable separator tapes may be applied over the fire barrier tape at the discretion of the manufacturer.

11 INSULATION

11.1 Elastomeric insulation shall be provided over the conductor (with heat barrier and or separator). The insulation shall be so applied that it fits closely on the conductor but shall not adhere to it.

11.2 Thickness of Insulation

The average thickness of insulation shall be not less than the nominal value (t_i) specified in Table 3.

NOTE — The thickness of fire barrier and separator tape if any on the conductor shall not be included in the thickness of insulation.

11.3 Tolerance on Thickness of Insulation

The smallest of measured values of thickness of insulation shall not fall below the specified values (t_i) by more than $0.1 \text{ mm} + 0.1 t_i$.

11.4 A glass tape may be provided on the insulation at the discretion of the manufacturer.

12 CORE IDENTIFICATION

12.1 The cores shall be identified by colours or numbers in accordance with **11.1** by using any of the following methods:

- a) Coloured insulation,
- b) Number printing on cores,
- c) Numbered tapes, and
- d) Coloured tapes.

12.2 The colour /number scheme shall be followed as under:

- a) *Core* — Red, Black, Yellow, Blue or Natural
- b) *Cores* — Red & Black or 1, 2
- c) *Cores* — Red, Yellow, Blue or 1, 2, 3
- d) *Cores* — Red, Yellow, Blue, Black or 1, 2, 3, 4
- e) *Cores* — Red, Yellow, Blue, Black, Grey or 1, 2, 3, 4, 5
- f) *Cores and above* — Two adjacent cores (counting and direction core) in each layer blue and yellow and remaining cores grey or by numbering 1, 2, 3, 4, 5, 6, ...

Cores shall be identified by the use of coloured strips/tapes (Red, Yellow, Blue for phase conductors) applied on the cores; alternately, numbered strip tapes or by printing of numbers (1, 2, 3) on the cores is permissible. When numerals are printed for identification these shall appear at intervals of not greater than 150 mm. Earth cores need not be identified but if required it can be either by green coloured strip/tapes applied on cores or by numbered strip/tapes or printing numeral '0'.

Identification of cores by use of coloured insulation compound or by surface colouring is also permissible. The colouring shall be as above.

13 LAYING UP OF CORES

13.1 The cores shall be laid up with a suitable lay; the outermost layer shall have right hand lay and the successive layers shall be laid with opposite lay. Wherever necessary, the interstices shall be filled with non-hygroscopic material to provide reasonable circularity of laid up cable. The recommended plan for lay of cores is given in Table 4.

13.2 A binder tape may be applied over laid-up cores.

14 INNER SHEATH

14.1 The laid up cores shall be provided with an inner sheath applied by extrusion in such a way that it fits closely on laid-up cores and it shall be possible to remove it without damage to the insulation. However unarmoured single core cables shall have no inner sheath except where otherwise stated or as agreed between manufacturer and user.

14.2 Thickness of Inner Sheath

The thickness of inner sheath at any point shall not be less than the value given in Table 5.

14.3 A glass tape may be applied over the inner sheath at the discretion of the manufacturer.

15 ARMOURING

15.1 The armour wherever required shall be applied over the inner sheath.

15.2 A glass tape may be applied over the armour at the discretion of the manufacturer.

15.3 Type of Armour

15.3.1 Armour shall consist of galvanized steel wire/formed wires to give a reasonable close cover. The size of armour shall be as given in Table 6.

15.3.2 In case of single core cables, the armouring shall be of non-magnetic material.

15.3.3 Direction of lay of armour shall be left hand. For double wire/strip armoured cables, this requirement shall apply to inner layer. The outer layer shall be applied in the reverse direction to the inner layer and there shall be a separator tape of suitable non-hygroscopic material between the layers.

15.3.4 When joints in armour wire/strips are necessary, these shall be brazed or welded and surface irregularities removed. A joint in any wire/strip shall be at least 300 mm from the nearest joint in any other armour wire/strip in the completed cable.

15.4 Test Requirements

The test requirements for galvanized steel wire /formed wire (strip) shall be as under:

15.4.1 The dimensions of galvanized steel wire/ormed wire (strip) shall be as per Table 4. However, for formed wire compliance shall be ensured only for dimension 'A' and 'C' as per IS 3975.

15.4.2 The round steel wires/formed steel wires taken from the cable shall meet the following requirements:

- a) The tensile strength of round steel wire/formed steel wire shall be not less than 250 N/mm² and not more than 580 N/mm².
- b) The elongation at break of round steel wire/formed steel wire shall be not less than 6 percent.
- c) Round steel wire shall meet the requirements of torsion test. The gauge length between the vices and the minimum number of turns without break shall be as per Table 6 of IS 3975.
- d) The zinc coating shall not show any cracks and shall not flake off on rubbing by the bare finger when the formed steel wire is subjected to winding test.
- e) The uniformity of zinc coating of round steel wire/formed steel wire shall comply with the requirements of IS 3975 subject to the following:
 - 1) The minimum number of dips shall be reduced by 1 half minute dip.
 - 2) In case of formed wires dip test is applicable only for the face.
- f) The mass of zinc coating of round steel wire shall not be less than 95 percent of the mass specified in Table 2 of IS 4826. The mass of zinc coating of formed steel wire shall not be less than 95 percent of the mass specified in IS 3975.
- g) The resistivity of the round steel wire/formed steel wire shall meet the requirements of IS 3975.

16 OUTER SHEATH

16.1 The outer sheath shall be applied by extrusion. It shall be applied

- a) over laid up cores with or without binder, in case of unarmoured multicore cables.
- b) over the armouring in case of armoured cables (both single core and multicore)
- c) over the insulation with or without binder tape, in case of single core unarmoured cables.

16.2 Colour of outer sheath shall be black or any other colour as agreed to between the purchaser and the supplier.

16.3 Thickness of Outer Sheath

16.3.1 Unarmoured Cables

The thickness of outer sheath of unarmoured cables determined by taking the average of number of measurements shall not be less than the nominal value (t_s) specified in Table 5 and the smallest of the measured values shall not fall below the nominal value (t_s) specified in Table 5 by more than $0.2 \text{ mm} + 0.2 t_s$.

16.3.2 Armoured Cables

The minimum value of outer sheath of armoured cables shall not fall below the nominal value (t_s) specified in Table 5 by more than $0.2 \text{ mm} + 0.2 t_s$.

SECTION IV TESTS

17 CLASSIFICATION OF TESTS

17.1 Type Tests

The test given in Table 1 shall constitute type tests.

17.2 Acceptance Tests

17.2.1 The following shall constitute the acceptance tests:

- a) Annealing test (for copper),
- b) Conductor resistance test,
- c) Test for thickness of insulation and sheath,
- d) Tensile strength and elongation at break test of insulation and sheath,
- e) Hot set test for elastomeric insulation and sheath,
- f) High voltage test,
- g) Insulation resistance (volume resistivity) test, and
- h) Circuit integrity test under fire condition.

17.2.2 A recommended sampling plan for acceptance tests is given at Annex A. However, circuit integrity test under fire condition shall be conducted only on one sample for each size.

17.3 Routine Tests

The following shall constitute the routine tests :

- a) Conductor resistance test, and
- b) High voltage test.

18 DETAILS OF TESTS

18.1 General

Unless otherwise stated in this standard, the tests shall

be carried out in accordance with appropriate part of IS 10810 (various parts) taking into account additional information given in this standard.

18.2 High Voltage Test

18.2.1 Type/Acceptance/Routine Test

The cable shall withstand, without breakdown, a power frequency ac voltage of 3 kV. The voltage shall be applied and increased gradually to the full value and maintained for 5 min.

18.2.2 For single core unscreened, unarmoured cables, the tests shall be carried out by immersing the cable in water at room temperature for at least 1 h (ends protruding) and then by applying the stipulated voltage between the conductor and the water.

18.3 Circuit Integrity Test Under Fire Condition

The test shall be carried out as per Annex B.

18.4 Flammability Test

18.4.1 Flame Retardance Test on Single Cable

After the test, there shall be no visible damages on the test specimen within 300mm from the upper end. Marks from fixing devices, soot or changing of colour are not considered damages.

18.4.2 Flame Retardance Test on Bunched Cables

After burring has ceased, the cable should be wiped clean and the charred or effected portion should not have reached a height exceeding 2.5 m above the bottom edge of the burner, measured at the front end rear of the cable assembly.

SECTION V IDENTIFICATION, PACKING AND MARKING

19 IDENTIFICATION

19.1 Manufacturer's Identification

The manufacturer shall be identified throughout the length of the cable by means of tape bearing the manufacturer's name or trade-mark, or by manufacturer's name or trademark being printed, indented or embossed on the outer sheath. In case none of these methods are employed or if purchaser so desires, coloured identification threads in accordance with a scheme to be approved by the Bureau of Indian Standards, shall be employed.

19.2 Voltage Identification

The voltage grade of the cable shall be identified throughout the length of the cable by means of a tape bearing the voltage grade of the cable (for example 1.1 kV or 1 100 V) or by printing, embossing or

indenting on the outer sheath.

19.3 Cable Identification

To differentiate this cable from others, the cable identification code 'FS' shall be provided by printing, embossing or indenting on the outer sheath or by a tape bearing the same information.

NOTE — Since tape giving information required in **18.1**, **18.2** and **18.3** is also permissible.

19.4 Cable Code

The following code shall be used for designating the cable:

<i>Constituent</i>	<i>Code Letter</i>
Elastomer Insulation (Rubber)	R
Steel round wire armour	W
Non-magnetic round wire armour	Wa
Steel strip armour	F
Non-magnetic strip armour	Fa
Double steel strip armour	FF
Double steel round wire armour	WW
Elastomer outer sheath	R

NOTE — When conductor material is copper, no code letter is required for conductor.

20 PACKING AND MARKING

20.1 The cable shall be wound on a drum (*see* IS 10814) and packed. The ends of the cable shall be sealed by means of non-hygroscopic sealing material.

20.2 The drum shall carry the following information either stenciled on it or contained in a label attached to it:

- Manufacturer's name or trade mark,
- Type of cable and voltage grade,
- Number of cores,
- Nominal cross-sectional area of conductor,
- Length of cable on the drum,
- Number of lengths on the drum (if more than one),
- Cable code,
- Direction of rotation of drum (by means of an arrow),
- Approximate gross mass, and
- Year of manufacture.

20.2.1 BIS Certification Marking

20.2.1.1 The cable (drum or label) may also be marked with the Standard Mark.

The use of the Standard Mark is governed by the provisions of the *Bureau of Indian Standards Act, 1986*

and the Rules and Regulations made thereunder. The details of conditions under which a license for the use of the Standard Mark may be granted to the

manufacturers or producers may be obtained from the Bureau of Indian Standards.

Table 1 Type Tests
(Clauses 3.2 and 17.1)

Sl No. (1)	Tests (2)	Requirements, Ref to (3)	Method of Test, Ref to Part of IS 10810 (4)
i)	Tests on conductor:		
	a) Annealing test (for copper)	IS 8130	Part 1
	b) Conductor resistance test	IS 8130	Part 5
	c) Persulphate test (tinned copper conductor)	IS 8130	Part 4
ii)	Tests for armouring wire/strips	8, Table 6 and IS 3975	Parts 36 to 42
iii)	Tests for thickness of insulation and sheath	11, 14 and 16	Part 6
iv)	Physical tests for insulation:		
	a) Tensile strength and elongation at break before ageing	IS 6380 IS 5831	Part 7
	b) Ageing in air oven	-do-	Part 11
	c) Ageing in air bomb	IS 6380	Part 56
	d) Hot set test	IS 6380	Part 30
v)	Physical tests for sheath:		
	a) Tensile strength and elongation at break before ageing	Table 2	Part 7
	b) Ageing in air oven	-do-	Part 11
	c) Hot set test	-do-	Part 30
	d) Oxygen index test	-do-	Part 58
	e) Temperature index test	-do-	Part 64
	f) Acid gas generation	-do-	Part 59
	g) Smoke density	-do-	Under preparation
vi)	High Voltage Test	18.2	Part 45
vii)	Insulation resistance test	IS 6380	Part 43
viii)	Water absorption test (for insulation)	IS 6380	Part 28
ix)	Flammability test:		
	a) Flame retardant test on single cable	18.4.1	Part 61
	b) Flame retardant test on bunched cable	18.4.2	Part 62
x)	Circuit integrity test under fire condition	18.3	

Table 2 Requirements of Inner and Outer Sheath Material
(Clause 9.1 and 9.2)

Sl No. (1)	Test (2)	Requirement (3)
i)	Oxygen index	30, <i>Min</i>
ii)	Temperature index	250, <i>Min</i>
iii)	Acid gas generation	2 percent by weight, <i>Max</i>
iv)	Smoke density rating	20 percent, <i>Max</i>
v)	Fire survival test at 750°C for 3 h	As per IS /IEC 60311 (Parts 11 and 21)
vi)	Tensile strength	6 N/mm ² , <i>Min</i>
vii)	Elongation at break	200 percent, <i>Min</i>
viii)	Ageing in air bomb:	
	a) Temperature	127 ± 1°C
	b) Duration	40 h
	c) Tensile strength, variation	± 50, <i>Max</i>
	d) Elongation at break, variation	± 50, <i>Max</i>
ix)	Hot set test:	
	a) Temperature	200 ± 3°C
	b) Mechanical stress	20 N/cm ²
	c) Hot set elongation	175 percent, <i>Max</i>
	d) Permanent elongation (set)	15 percent, <i>Max</i>
x)	Oil resistance test:	
	a) Oil temperature	100 ± 2°C
	b) Duration	24 h
	c) Tensile strength, variation	± 40, <i>Max</i>
	elongation at break, variation	± 40, <i>Max</i>

Table 3 Insulation Thickness
(Clause 11.2)

Sl No.	Cross-Sectional Area of Conductor	Thickness of Insulation Nominal (t_i)
(1)	mm ² (2)	mm (3)
i)	1.0	1.0
ii)	1.5	1.0
iii)	2.5	1.0
iv)	4.0	1.0
v)	6.0	1.0
vi)	10	1.2
vii)	16	1.2
viii)	25	1.4
ix)	35	1.4
x)	50	1.6
xi)	70	1.6
xii)	95	1.8
xiii)	120	1.8
xiv)	150	2.0
xv)	185	2.2
xvi)	240	2.4
xvii)	300	2.6
xviii)	400	2.8

Table 4 Recommended Lay Up of Cores
(Clauses 13.1 and 15.4.1)

Sl No.	No. of Cores	Lay-Up	No. of Cores	Lay-Up	No. of Cores	Lay-Up
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	2	2	36	0-6-12-18	70	2-8-14-20-26
ii)	3	3	37	1-6-12-18	71	2-8-14-20-27
iii)	4	4	38	1-6-12-19	72	2-8-14-21-27
iv)	5	5	39	1-6-13-19	73	3-9-15-20-26
v)	6	6	40	1-7-13-19	74	3-9-15-21-26
vi)	7	1-6	41	1-7-13-20	75	3-9-15-21-27
vii)	8	1-7	42	2-8-13-19	76	3-9-15-21-28
viii)	9	1-8	43	2-8-14-19	77	3-9-15-22-28
ix)	10	2-8	44	2-8-14-20	78	4-10-15-21-28
x)	11	3-8	45	2-8-14-21	79	4-10-16-22-27
xi)	12	3-9	46	3-9-14-20	80	4-10-16-22-28
xii)	13	3-10	47	3-9-15-20	81	4-10-16-22-29
xiii)	14	4-10	48	3-9-15-21	82	4-10-16-23-29
iv)	15	5-10	49	3-9-15-22	83	4-10-17-23-29
v)	16	5-11	50	3-9-16-22	84	5-11-17-23-28
vi)	17	5-12	51	4-10-16-21	85	5-11-17-23-29
vii)	18	0-6-12	52	4-10-16-22	86	5-11-17-23-30
viii)	19	1-6-12	53	4-10-16-23	87	5-11-17-24-30
xix)	20	1-7-12	54	4-10-17-23	88	5-11-18-24-30
xx)	21	1-7-13	55	4-11-17-23	89	6-11-18-24-30
xxi)	22	2-7-13	56	5-11-17-23	90	6-12-18-24-30
xxii)	23	2-8-13	57	5-11-17-24	91	1-6-12-18-24-30
xxiii)	24	2-8-14	58	5-11-18-24	92	1-6-12-18-24-31
xiv)	25	2-8-15	59	5-12-18-24	93	1-6-12-18-25-31
xv)	26	3-9-14	60	0-6-12-18-24	94	1-6-12-19-25-31
xvi)	27	3-9-15	61	1-6-12-18-24	95	1-6-13-19-25-31
xvii)	28	3-9-16	62	1-6-12-18-25	96	1-7-13-19-25-31
xviii)	29	4-10-15	63	1-7-12-18-25	97	1-7-13-19-26-31
xix)	30	4-10-16	64	1-7-13-18-25	98	2-8-13-19-25-31
xx)	31	4-10-17	65	1-7-13-19-25	99	2-8-14-19-25-31
xxi)	32	5-11-16	66	1-7-13-19-26	100	2-8-14-20-25-31
xxii)	33	5-11-17	67	2-8-13-19-25		
xxiii)	34	5-11-18	68	2-8-14-19-25		
xxiv)	35	5-12-18	69	2-8-14-20-25		

NOTES

1 The figures indicate the number of cores in each successive layer, for example, 5-11-18 means, 5 cores in the first, 11 cores in the second and 18 cores in the third layer, etc.

2 This table is for guidance only.

Table 5 Thickness of Sheath
(Clauses 14.2, 16.3.1 and 16.3.2)
All dimensions in millimetres.

Sl No.	Calculated Diameter Over Laid-up Cores/Over Screen for Single Core Cables (Ref to, IS 10462 (Part 1))		Thickness of Inner Sheath	Thickness of Outer Sheath
	Above	Up to and Including	Min	Nominal (t_s)
(1)	(2)	(3)	(4)	(5)
i)	—	10	0.8	1.2
ii)	10	15	1.0	1.5
iii)	15	20	1.0	1.7
iv)	20	25	1.2	1.9
v)	25	30	1.2	2.1
vi)	30	40	1.4	2.4
vii)	40	50	1.6	2.7
viii)	50	60	1.8	3.1
ix)	60	70	2.0	3.5
x)	70	80	2.2	3.8
xi)	80	—	2.4	4.0

Table 6 Dimensions of Armour Round Wires and Strips
(Clause 15.3.1)

All dimensions in millimetres.

Sl No.	Calculated Diameter under Armour (Ref to, IS 10462 (Part 1))		Thickness of Steel Strip	Diameter of Round Wire
	Above	Up to and Including	Nominal	Nominal
(1)	(2)	(3)	(4)	(5)
i)	—	13	—	1.40
ii)	13	25	0.8	1.60
iii)	25	40	0.8	2.00
iv)	40	55	0.8	2.50
v)	55	70	0.8	3.15
vi)	70	—	0.8	4.00

ANNEX A

(Clause 17.2.2)

SAMPLING OF CABLES

A-1 LOT

In any consignment the cables of the same size manufactured under essentially similar conditions of production shall be grouped together to constitute a lot.

A-2 SCALE OF SAMPLING

A-2.1 Samples shall be taken and tested from each lot for ascertaining the conformity of the lot to the requirements of the specification.

A-2.2 The number of samples to be selected shall be as given below :

<i>No. of Drums in the Lot</i>	<i>No. of Drums to be Taken as Sample</i>	<i>Permissible No. of Defectives</i>
(1)	(2)	(3)
Up to 25	3	0
26 – 50	5	0
51 – 100	8	0
101 – 300	13	1
301 and above	20	1

A-2.3 These samples shall be taken at random. In order to ensure the randomness of selection, procedure given in IS 4905 may be followed.

A-3 NUMBER OF TESTS AND CRITERION FOR CONFORMITY

From each of the drums selected, suitable lengths of test samples shall be taken. These test samples shall be subjected to each of the acceptance tests (*see* 16.2). A

test sample is called defective, if it fails in any one of the acceptance tests. If the number of defectives is less than or equal to the corresponding permissible number given in col 3 under A-2.2, the lot shall be declared as conforming to the requirements of acceptance tests; otherwise note.

ANNEX B

(Clause 18.3)

CIRCUIT INTEGRITY TEST

B-1 APPARATUS

B-1.1 Sample Supporting System

The cable sample shall be held horizontally by means of suitable clamps at each end of the sheathed or protected portion. The middle portion of the cable shall be supported by two metal rings placed approximately 300 mm apart; these, as well as any other metal parts of the supporting apparatus, shall be earthed.

B-1.2 Voltage Source

One 3 phase star connected or three single phase power transformers of not less than 3 A capacity at test voltage shall be provided (alternatively, the test may be made with direct current at a voltage equal to peak value of alternating voltage). The transformer shall be connected to the cable through a 3 A fuse in each phase and a 5 A shall be inserted in the neutral circuit which shall be earthed. The cores of the cable under test shall be connected to separate phases, and when more than three cores are present, they shall be grouped into three sets for connection to the three phases. Adjacent conductors shall be connected to different phases.

B-1.3 Source of Heat

The source of heat shall be 610 mm long tube type gas burner which produces a line of closely spaced flames.

B-1.4 Temperature Measurement

Platinum–Iridium thermocouple.

B-1.5 Test Chamber

The test shall be carried out in a suitable chamber (maintained in an external environment where the temperature is between 5°C and 40 °C) providing by means of disposing of obnoxious gases resulting from burning. Draught shields may be fitted near the burner, if required.

B-1.6 Fuel

Propane or town gas or LPG with forced air supply to achieve a temperature of 750 °C (– 0 to 20 °C) flame temperature when measured as indicated in 6.1.

B-2 TEST SPECIMEN

B-2.1 A sample of the completed cable approximately 1 200 mm long shall have approximately 100 mm of sheath or outer coverings removed at each end. At each end of the cable, each conductor shall be suitably prepared for electrical connections, and the exposed conductors shall be spread apart to avoid contact with each other.

B-2.2 Only one sample is to be tested.

B-3 PROCEDURE

B-3.1 An unearthed platinum-iridium thermocouple shall be inserted in the flame at the end close to the gas burner inlet with the couple parallel to the burner and situated 75 mm above it. The gas and air supplied shall then be adjusted until a temperature of 750 °C (–0 to +20 °C) is registered by the thermocouple.

B-3.2 The electrical supply shall be switched on and the voltage adjusted to that of the rated voltage of the cable and this shall be applied continuously during the test. The test voltage between cores shall equal the rated voltage between cores, and test voltage from core to earth shall equal the rated voltage from core to earth. The cable is then lowered into position so that it is parallel with the burner, and the lower surface of the cable is 75 mm above the burner.

B-3.3 The thermocouple may then be removed (It is found convenient before lighting the burner or electrifying the cable to adjust the apparatus so that the cable may be lowered into position without a great deal of readjustment of cable at start of the test).

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B-3.4 The flame and test voltage shall be applied continuously for a period of 3 h.

B-3.5 Not less than 12 h after the flame has been extinguished; the test voltage shall be applied for a period of 1 min (maximum).

B-3.6 In case of single core cables, the voltage test shall be carried out between core and earth using supporting metallic rings of the apparatus as the earth. The earthing efficiency of the metal rings may be enhanced by making an earth contact by means of a lightly loaded metal bar hinged suitably to the back of the ring holder and resting on the cable.

B-4 TABULATION OF OBSERVATION

Sl No.	Cable Description	Temperature at which Test is Done	Voltage Applied	Sample Length	Number of hours Under Flame	Voltage Withstand During Test	Voltage Withstand after 12 h of Stoppage of Flame
		°C	V	mm	h	Yes/No	Yes/No

B-5 PERFORMANCE REQUIREMENT

Cable sample is considered to have passed this test, if no failure of any of the 3 A fuses occurs during test, and if the withstand voltage after 12 h on completion is not less than the rated voltage of the cable.

B-6 CALCULATION

No calculation to be done.

B-7 REPORT

- Reference specification
- Material under test
- Temperature
- Conclusion: Specimen meets/does not meet the specification requirements

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